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NATIONAL STRATEGY FOR PROTECTING THE INFRASTRUCTURE: A VISIONARY APPROACH

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ABSTRACT

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Does the August 2003 power outage in the Northeastern United States and Canada indicate how vulnerable our critical national infrastructure is to failure? This SRP addresses such concerns about the viability of our critical national infrastructure, using dams as a case study. The question therefore becomes how the nation should protect infrastructure whose destruction or dysfunction poses a threat to our citizens, not from terrorism, but rather from years of maintenance neglect.

This SRP considers the vulnerability of the nation's infrastructure from this broader perspective, and offers a visionary approach to resource allocation to deal with the challenges facing our infrastructure. This paper will briefly review the Critical Infrastructure Strategy and illustrate how it falls short of achieving a more secure infrastructure because the ways chosen are insufficient to bring about the ends. The focus is on the resource allocation process since it is arguably the most important of the common ways to fully leverage investments in infrastructure. Dams serve as an excellent case study because of their complexities, including ownership issues, access to funding and current material condition and age. Finally, how the proposal can be implemented within the federal budget.

TABLE OF CONTENTS

LIST OF TABLES

NATIONAL STRATEGY FOR PROTECTING THE INFRASTRUCTURE: A VISIONARY APPROACH

The open nature of American Society makes it an inviting and vulnerable target to terrorism. The United States government cannot guarantee protection of the national interests and infrastructure, yet that is what many citizens expect. The threat facing the nation's infrastructure is immense, not only from terrorism, but also from years of maintenance neglect. Perhaps the August 2003 power outage in the Northeastern United States indicates how vulnerable our critical national infrastructure is to terrorism.

The government attempted to address the challenge of terrorism formally after the catastrophic attacks of 11 September 2001. The Physical Protection of Critical Infrastructure and Key Assets Strategy was recently adopted, and signed by the President in February 2003[1]. It specifies the guiding principles, goals and objectives to secure our nation's critical infrastructure in support of our national security. According to former Senators Gary Hart (D-COL) and Warren B. Rudman (R-VT), "Pursuing America's homeland security imperatives immediately may be the most important thing we can do to sustain our cherished freedoms for future generations"[2]. Unfortunately, the strategy considers only the threat of terrorism, and we should consider other significant issues facing our national infrastructure.

THESIS

The question therefore becomes how the nation should protect infrastructure whose destruction or dysfunction poses a threat to our citizens, not from terrorism, but rather from years of maintenance neglect. This SRP considers the vulnerability of the nation's infrastructure from this broader perspective, and offers a visionary approach to resource allocation to deal with the challenges facing our infrastructure.

This paper will briefly review the Critical Infrastructure Strategy and illustrate how it falls short of achieving a more secure infrastructure because the ways chosen are insufficient to bring about the ends. The focus is on the resource allocation process since it is arguably the most important of the common ways to fully leverage investments in infrastructure.

Furthermore, rather than broadly focusing on all sectors of infrastructure, the paper will address only dams. Dams serve as an excellent case study because of their complexities, including ownership issues, access to funding and current material condition and age. Finally, the paper will include a recommendation on implementation options within the federal budget.

A recent report by the American Society of Civil Engineers (ASCE) aptly noted that our infrastructure might fail for reasons other than terrorism:

> "American's concerns about security threats are real, but so are the threats posed by crumbling infrastructure," Thomas Jackson, ASCE president stated in his statement. "It doesn't matter if the dam fails because cracks have never been repaired of if it fails at the hands of terrorists. The towns below the dam will still be devastated."[3]

ASCE's report in March 2001, graded the twelve categories of infrastructure at a discouraging D-, with an estimated bill of $1.3 trillion. Since that report, the overall condition has deteriorated further, thereby increasing the required resources to approximately $1.6 trillion over the next five-year period[4]. To put that number in perspective, the FY2002 federal budget receipts were only $1.853T[5], and the nation's overall gross domestic product (GDP) is only $10.481T[6]. Therefore, the resourcing challenge facing the nation amounts to 15.26% of the current annual GDP. Unfortunately, the problem will only grow worse if we fail to act decisively in the very near future.

CRITICAL INFRASTRUCTURE STRATEGY

The Physical Protection of Critical Infrastructure and Key Assets Strategy, adopted and signed in February 2003, is one of two supporting strategies to the National Homeland Security Strategy[7]. It specifies the guiding principles, goals and objectives necessary to secure our nation's critical infrastructure (ends) in support of our national objectives. Implementation of the strategy (ways) will undoubtedly take many years, given the magnitude of the critical infrastructure and the nature of the terrorist threat. Finally, the capital resources (means) to protect the infrastructure are extremely limited. Since the infrastructure is vast and technically diverse, it requires many different kinds of protection.

The national strategy resulted from many months of consultation among public and private sector interests. It included inputs from federal, state and local governments, private sector owner/operators, and representatives from scientific and professional organizations, as well as interested American citizens. It provides a roadmap for the future security of the nation's infrastructure.

The strategy seeks to improve overall physical security of the nation's infrastructure by identifying a responsible lead agency for the necessary efforts to protect critical infrastructure sectors. These sectors are: agriculture and food, water, public health, emergency services, government, defense industrial base, telecommunications, energy, transportation, banking and finance, chemical industry/hazardous materials, postal and shipping, and national monuments and icons. In addition to those sectors, it identifies five categories of key assets - national monuments and icons, nuclear power plants, dams, government facilities, and commercial key

assets[8]. This SRP focuses on only one of the strategy's special asset categories, dams, and offers a case study for understanding the complexity of securing our national infrastructure.

Several ways to improve the nation's critical infrastructure sectors apply to the majority if not all sectors. Accordingly, the strategy identifies five important *cross sector* priorities to optimize security with limited resources: Planning and Resource Allocation; Information Sharing and Indications and Warnings; Personnel Surety– Building Human Capital and Awareness; Technology and Research and Development; and finally Modeling, Simulation and Analysis. The five prioritized cross sector ways to protect our infrastructure form the important near-term priorities for the nation because they encompass issues common to all of the sectors[9].

The strategy calls for initially focusing national efforts on these five cross-sector ways to fully leverage investments to improve overall security. High leverage efforts, such as the five cross-sector priorities, will improve the nation's critical infrastructure security. However, they cannot be fully implemented in the near future so the strategy falls short of achieving a more secure infrastructure (ends) because the ways chosen are insufficient to bring about the ends. This paper considers only one of those five priorities, planning and resource allocation, and proposes a more aggressive application of our budgetary resources to the nation's infrastructure, using dams as a case study.

DAM INFRASTRUCTURE

The 79,000 dams in the United States are a critical portion of the nation's infrastructure[10]. They have been identified as one of the five key asset categories in the national strategy for the Physical Protection of Critical Infrastructure. Dams provide economic, environmental and social benefits including hydroelectric power, river navigation, wildlife habitats, waste management, flood control, and recreation and water supply.

Water is a precious resource, and it has to be in the right place at the right time to support life. Throughout history, people have built dams to maximize this critical resource. Today, dams support communities and the nation in many of the ways listed above. As the nation's population grows and more people move to arid locations, the need for dams increases. Millions of people throughout the western United States depend on dams to bring them the benefits listed above. They are extremely important portion of the nation's infrastructure because they simultaneously serve several functions at once, especially hydropower.

During the August 2003 blackout in the Northeast, hydropower was the key to restoring electric grid stability and restoration of power to the 50 million people affected. Within six hours of the initial blackout, New York Power Authority's hydropower generation was returned to the

electric grid, and provided 3,794 megawatts of energy, almost 45 percent of the state's electrical load[11]. Hydropower (from dams) are an often forgotten component of our national electric grid.

Safety is the key to an effective dam program. A dam failure can be devastating to the downstream population and the dam owners. Failures also obviously thwart the intended primary purpose of the dam. Economic affects of dam failure can also be tremendous, ranging into the billions of dollars. According to the Association of State Dam Safety Officials (ASDO), the six top dam safety issues in the United States are: risk of failure; increasing hazards due to downstream population growth; financing shortages; lack of adequate authority and resources for State Dam Safety programs; lack of emergency preparedness in case of dam failure; and lack of public awareness about current material conditions[12].

According to ASDO, of the 74,889 non-federal dams, approximately 10,000 are now considered high hazard dams[13]. High hazard dams would result in significant loss of life if failure occurred. The federal government has made improvements in dam safety, but those efforts will not reduce the risk the nation currently faces given the complexities of this sector of our national infrastructure.

OWNERSHIP ISSUES

Overcoming the challenges facing the dam infrastructure is extremely complex because of ownership issues. Most dams in the United States, approximately 58%, are privately owned. The remaining dams are owned by local governments (17%), and states (4%), with the federal government and public utilities owning the remainder[14]. The federal government owns very few dams, and therefore has limited responsibility for ensuring non-federal dams are well maintained. The federal government can regulate standards, but it is the responsibility of the dam owners to meet those standards, and there are significant legal barriers to successful public-private partnerships.

ACCESS TO FUNDING

Many of the dams considered unsafe are privately owned. In many cases, the owners do not have access to the financial resources necessary to correct the deficiencies. Recent efforts, including the National Dam Safety Act (P.L. 107-310) provide funding for improvements in inspections and enforcement, but it does not provide funding to conduct repairs[15]. Thus, although non-federal dam owners and operators have to meet federal safety requirements, they often have no source of funding available for that purpose.

MATERIAL CONDITION

Unfortunately, but not unexpectedly, many of the dams across the nation are in need of significant upgrades and repairs. Like much of the nation's infrastructure, dams pose a potential threat to life, health and property due to both increased age and deterioration. According to the Association of State Dam Safety Officials, between 2000 and 2002 there were 520 reported dam incidents, including more than 60 dam failures. Fortunately, the majority of these failures were small low hazard irrigation dams. In addition to those incidents, the Association evaluates more than 2,400 dams nationwide as unsafe, and in need of corrective action.[16.]

A VISIONARY STRATEGY FOR INFRASTRUCTURE

The visionary approach proposed in this paper has three key elements: a historical context; a prioritization process; and a determination if America is ready for such an endeavor. Understanding of the proposal relies heavily on an important historical context, President Eisenhower's vision to build the Interstate Highway System which built upon President Roosevelt's New Deal programs.

HISTORICAL CONTEXT

Roosevelt's New Deal

After President Roosevelt took office in 1933, he immediately created numerous federal programs to provide relief, create jobs and stimulate an economic recovery. The collection of programs throughout his thirteen years in the oval office was known as "The New Deal". Two of these New Deal programs contributed significantly to President Eisenhower's later success with the National Highway Act of 1956.

First, the Public Works Administration (PWA) provided $3.3 billion to fund 13,266 federal projects and 2,407 non-federal projects, including several dams and irrigation projects [17]. One of the PWA program's largest efforts was the Columbia River Basin Irrigation Project in central Washington. The project included the Grand Coulee Dam on the Columbia River. Today, Grand Coulee Dam provides more than 6480 MW of power, making it the largest producer of hydroelectric power in the United States [18]. Obviously, the nation is still greatly benefiting from that historic program.

Later in 1935, the Works Progress Administration (WPA) was created to likewise help provide economic relief to the citizens of the United States who were still suffering through the Great Depression. The WPA was the largest and arguably most important component in the New Deal program. Intended as a massive employment and relief program, it was launched in

the spring of 1935 to preserve the employment skills and self-esteem of American citizens. The WPA built 65,000 miles of road, 125,000 public buildings, and 800 airports –the majority of which are still in use today[19]. However, this program, like the PWA failed to produce a national highway system.

Eisenhower's Vision

The approach advocated in this paper is a national critical infrastructure program similar to one proposed by President Eisenhower in the mid 1950s. That vision resulted in the National Highway System. President Eisenhower proposed and strongly lobbied for the 1956 Highway Act. Ensuing legislation provided $27.5 billion over a thirteen-year period to build the Interstate Highway System[20]. The $27.5B project equaled approximately 6.3% of the 1956 national GDP ($437.5B)[21]. Eisenhower's vision built upon those begun during the Roosevelt administration and significantly improved the disparate efforts of the Bureau of Public Roads (BPR). President Eisenhower's vision served to unify a truly national network of superhighways. Neither of President Roosevelt's major efforts, the Works Progress Administration (WPA) or Public Works Agency (PWA) programs, attempted a superhighway program.

Eisenhower's Success

Five reasons enabled Eisenhower to build a highway system. During Roosevelt's administration there was little need for a highway system. However, during Eisenhower's administration the availability of skilled labor, the need for highways, and a demand for consumer goods, reinforced Eisenhower's leadership on the program.

First, during Roosevelt's administration, automobiles were new to the market. Consequently, they were luxuries to many families during the Depression. Therefore, families sold their vehicles to raise money for basic living necessities. In essence there was no demand for a highway program.

Secondly, Roosevelt's WPA and PWA programs were structured to retain American construction and engineering skills. During the depression those skills did not deteriorate, rather they improved as evidenced by major efforts including Grand Coulee Dam. Without those skills many of the engineers needed to build the National Highway system may not have been available.

Furthermore, the need for a national highway system was not realized until World War II. President (then General) Eisenhower witnessed first hand Germany's extensive highway system. The Autobahn was critical to Germany's ability to move military troops and supplies

during the European military campaign. Eisenhower did not forget this important lesson, and understood the significant economic potential of the Autobahn.

Fourthly, by the mid 1950's, Americans demanded more consumer products. Simultaneously, the housing boom was in full swing and American suburbs were developing. The United States needed national highways to facilitate the expansion of the nation.

Finally, the Highway Act represented a significant domestic agenda item for President Eisenhower. Americans were focused on internal postwar issues and consumer demands, and Eisenhower's vision met those needs. In other words, Eisenhower's leadership coupled with public support made the vision a reality.

This paper suggests the United States can enact a Nationwide Critical Infrastructure Improvement Plan using Eisenhower's National Highway Program as a successful model. Today, the circumstances in the United States are similar to those in the Eisenhower administration. However, first let us consider a prioritization process for the projects contained in the proposal.

PRIORITIZATION PROCESS

A recent study by the Brookings Institute "Protecting the American Homeland, One Year On" identifies the annual costs of improving physical protection of key targets[22] The report clearly articulates that, because of the vastness and complexity of the issue, we must prioritize our efforts. The costs of improved security across our national infrastructure must first be allocated on those areas where failure of the infrastructure has the potential for significant loss of life. We must acknowledge, though, that improving the security is irrelevant if the infrastructure fails due to lack of maintenance. Therefore, investment in security must be tied to infrastructure improvement programs. That is, it is essential to maintain, or if necessary, upgrade the infrastructure that we are protecting. Thus funding a coordinated program is critical to an improved critical infrastructure security plan.

Further, because the financial resources necessary to meet these objectives are extremely scarce, the federal government must develop a multi layered strategy that incorporate the nation's political, social, and economic objectives – a strategy that can be successfully implemented over the next several decades. One proposal would categorize the nation's infrastructure into one of three (or more) classifications based on the overall urgency of repair/protection. The categories could be: A – Extremely urgent/fully addressed and funded in the next five years; B – Urgent/fully addressed and funded in the next eight years; and finally, C – Important/fully addressed and funded in within ten to fifteen years.

The following example serves to clarify these categories. The nation's diversified fresh water and agriculture infrastructure are less vulnerable due to their multiple sources and wide dispersal across the United States. In other words, we enjoy considerable redundancy in sources of both food and water. Therefore, those infrastructure sectors would be assigned a lower priority, possibly spread across two or three categories. However, a single source of water for a region may be prioritized higher simply because it is the sole provider for a large population center.

On the other hand, dams should be prioritized in the higher categories because of their economic significance and the large number of lives that could be lost if they failed. For example, the loss of a significant dam or reservoir affects water supplies and possibly power generation; likewise, such a loss risks the lives of the people below the dam. "Protecting the American Homeland, One Year On", suggests similar prioritization and analyzes the potential economic ramifications of several terrorist incidents against critical infrastructure.[23]

IS AMERICA READY FOR SUCH A PROGRAM?

Leadership

Publicizing the need for a major national effort to improve our nation's critical infrastructure should mobilize the nation for this ambitious program. Generally, Americans want their leaders to address national challenges, and improving our infrastructure will be a significant endeavor. As mentioned earlier, the commitment of the administration towards such an ambitious goal provides a significant impetus in executing the vision. In times of crisis or national emergency, American citizens seek leadership from the President. Therefore, a vision to upgrade and secure the nation's infrastructure would be a significant endeavor, and a positive legacy for any administration. However, because of the magnitude of the challenge the nation must first focus on the highest priority infrastructure, the five key asset categories, which include dams and reservoirs.

Public Support

Public support is achievable because American citizens benefit from a well-maintained and secure infrastructure. The program scope includes almost every community in the nation because of the dispersion of our infrastructure. Congressional support seems reasonable because of the program's potential benefits to constituents who focus on local issues. The program could reduce social tensions in many urban/rural areas where entry-level jobs are scarce and furthermore increase productivity across the economy[24]. Heightened public

awareness and support could justify the enormous quantity of resources required to improve our nation's infrastructure. Proponents of the program should help the public understand the opportunity costs of such an effort. American citizens need to fully understand the long-term economic benefits of investing today in the future of the nation. Significant investments today would provide three major longer-term benefits: an expansion of our national capabilities and an increase in productivity; correction of significant deficiencies in our infrastructure (i.e., power grid); and thirdly, replacement of older systems with technology and standards exceeding environmental regulations enacted after the nation's infrastructure was originally built.

Let us now consider how implementation of this vision of a more secure, well-maintained national infrastructure would affect a single component of that infrastructure, specifically the nation's dams.

THE VISION FOR DAMS AND RESERVOIRS

As noted above, dams are an excellent case study because of their complexities and challenges. To fully appreciate the issue, let us briefly apply the three key components of the proposal: historical context, prioritization process, and discussion is America ready to improve dam safety.

HISTORICAL CONTEXT

Although the federal government has taken steps to ensure the overall condition of the nation's dams, the majority of legislation has been too narrowly focused to address national issues. For example, in November 2000, President Clinton signed legislation, the Small Watershed Dam Rehabilitation Act of 2000 (P.L. 106-472) that provides some funding for small dam rehabilitation projects. This legislation authorized $90M over a five-year period to cover up to 65 percent of the total costs to local organizations for rehabilitating small watershed dams. However, the funding was available only to correct deficiencies of the 10,000 dams constructed by the Department of Agriculture under the Small Watershed Protection and Flood Prevention Act, as well as several other flood control legislative programs. Similarly, the Water Resources Development Act of 2000 funded an assessment of dams built by the Works Progress Administration. Unfortunately, it applies only to dams built in Minnesota and Vermont[25].

In 2002, Public Law 107-171 endorsed and enhanced the Small Watershed Dam Rehabilitation Program and increased funding to $275M over five years, with an additional $325M authorized for appropriation of similar projects[26]. The funding supports the 10,450 small flood control dams originally built by the federal government and subsequently turned over to

local and state governments for maintenance and operation. This legislation has been significant to improve local governments' ability to deal with the maintenance issues on these dams.

The most recent legislation, the National Dam Safety Act, evolved from the Water Resources Development Act of 1996. It gives FEMA the authority to administer a national program for dam safety. The bill was amended and reauthorized in December 2002 as the National Dam Safety Act of 2002; it was the first comprehensive effort to deal with the nationwide challenge of dam safety[27]. Unfortunately, the legislation does not provide assistance or funding to state and local dam safety officials which reinforces the need for the visionary proposal in this paper. As can be seen, the efforts to improve national dam safety have not been adequate; rather they have been focused on a narrow portion of the infrastructure.

PRIORITIZATION PROCESS

All dam owners should qualify for funds to implement the Physical Protection of Critical Infrastructure and Key Assets Strategy. Since, the federal government is currently funding it's dams, excluding them reduces the national inventory from 79,000 to 74,899. Logically those 74,899 dam owners/operators should have access to funding if their dams are deemed in significant disrepair and a threat to public safety. Funds should be available to correct deferred maintenance; to conduct engineering studies and assessments; to conduct hazard reclassification studies; and to physically improve the structures to include additional physical security upgrades. Local and state dam safety officials could conduct the necessary inspections and determine the project's prioritization.

Funding is critical, but the magnitude of the overall problem must first be defined. As mentioned earlier, the estimated cost to fix the nation's critical infrastructure is approximately $1.6T. Fortunately, the financial challenge for repairing and upgrading the nation's dams is much less significant. A recent study, based on the current national inventory of dams, estimates the resources necessary to correct the nation's dams at $36.2B. Table 1 illustrates the distribution of the $36.2B[28]. These estimates do not include any administrative costs involved with managing and dispersing the funds, so final costs would be somewhat higher than those listed. However, these administrative costs could be minimized using efficient existing programs to administer the funds.

Dam Height	Percent of Dams in Need of Rehabilitation	Cost Estimate for Rehabilitation	Total Cost
Less than15 feet	42.1% = 15,958	$ 210,413/project	$ 1.514 Billion
16 feet to 25 feet	44.3% = 25,256	$ 463,623/project	$ 5.448 Billion
26 feet to 50 feet	43.1% = 28,315	$1,236,027/project	$15.498 Billion
Over 50 feet	38% = 5,360	$6,659,877/project	$13.735 Billion
			$36.195 Billion

TABLE 1 REHABILITATION COSTS OF NON-FEDERAL DAMS (BY SIZE) [29]

IS THE FEDERAL GOVERNMENT READY? STATE PROGRAMS AS TEMPLATES

Currently, only nine states maintain programs that provide financial loans and grants to repair unsafe dams. One of those state programs could be used as a template for a federal program. This case study uses the Pennsylvania program as a model for a potential federal program. Pennsylvania has been a leader in dam safety efforts for more than twenty years; their efforts will clearly demonstrate how to structure a federal funding dam safety-funding program.

Leaders in the Pennsylvania State government realized many years ago that many dams in the state were approaching 200 years old and in immediate need of repair to maintain their safety and viability. At the onset of the program, officials estimated nearly one-third of the 3,200 dams in Pennsylvania, about 950, were potentially high-hazard dams, promising a significant loss of life or damage to property if failure occurred. During the past twenty years, the Pennsylvania dam safety program has monitored and corrected significant deficiencies at 205 dams at a cost of approximately $240M[30]. All of these dams were “unsafe” with the potential for failure if the deficiencies were not adequately addressed.

Remarkably, as of late 2003, Pennsylvania dam safety officials estimated the state has 34 dams with newly identified structural deficiencies and approximately 300 high-hazard dams in immediate need of repair. The cost estimates to correct problems at those dams range as high as $400 million[31]. The majority of the owners of these dams have been unable to correct the deficiencies because of limited financial resources, lack of maintenance, and the age of the dams. Furthermore, recent wet winters have added to runoff and additional erosion challenges at many smaller dam sites, thereby increasing the potential problem. Pennsylvania authorities are working hard to address the challenges given the limited availability of fiscal resources. To ensure programs like Pennsylvania’s can continue to succeed, the federal government must provide access to funding to mitigate the risk of non-federal dam failures. Such funding is a key

component of the proposal recommended in this paper. A successful model is found in Pennsylvania's funding program, PENNVEST.

Pennsylvania Infrastructure Investment Authority (PENNVEST)

PENNVEST, the Pennsylvania Infrastructure Investment Authority, is a successful Pennsylvania State program that could be used as a model for a nationwide infrastructure improvement program. It began in 1988 to provide low-interest loans and grants to owners and operators of dams, sewers, water, water treatment, and storm water systems. The loan interest rates range between 1 and 5%; they are available for up to 100% of the total project costs.

PENNVEST operates on a $300M budget per year, with $50M coming directly from the federal government, specifically the Environmental Protection Agency (EPA). The remainder of the initial funding came from several bond referendums. Today, the program operates as a semi-independent state agency. It is self-funding, using interest received on current projects to provide the funds necessary to fund additional projects. The only annual funding received is the $50M from the EPA, which critically provides approximately 10% of PENNVEST's annual budget.

Loan rates are determined by the local unemployment rates, with the lowest interest rates charged to owners in areas with higher unemployment rates, thus helping to target resources to the areas that need them the most. Over the history of the program PENNVEST has approved funding for 1774 projects, (686 water; 999 wastewater; 89 storm water), dispersing over $3.3B.[32] The projects have credited in 116,905 construction jobs and an additional 39,382 permanent jobs within the state[33].

To keep administrative costs low, PENNVEST relies on state agencies to determine the priorities for the state projects. It functions only as the fund administrator, and therefore circumvents the politics of resource allocation. Any eligible owner/operator can request PENNVEST funds based on their projects' most recent state mandated inspection. Therefore, the state safety officials determine the prioritization, allowing the dam owner to then go directly to PENNVEST for funding without having to administratively justify their request. This arrangement enables PENNVEST to fully utilize its resources annually. In 2002-2003 PENNVEST funded 120 projects totaling $284.1 million and provided an additional $38.5 million in grants. During the past fifteen years on average PENNVEST has provided $280M annually for the low interest loans with an additional $20M for grants.

Similarly, the Task Committee of the Association of State Dam Safety Officials offers a detailed set of recommendations on how federal funding assistance can be administered at both

the state and federal levels[34]. The Committee suggests that funding programs be modeled after several successful state efforts, such as PENNVEST. Among their recommendations: US Army Corps of Engineers and/or FEMA administer the funding; only non federal dams should be eligible; and new construction projects should not be eligible.

RESOURCE REQUIREMENTS AND RISK

RESOURCE REQUIREMENTS

Based on ASDO's estimates, the federal government would need to provide $10.1 billion over the next twelve years to deal with the most significant challenges facing the nation's dams[35]. The $10.1 billion equates to less than 0.0010 percent of 2002 annual GDP. This allocation certainly is within the capabilities of the federal budget; especially considering the EPA is already providing some level of funding to the states. To fully repair and upgrade the nation's dams, the nation would need to provide the $37.2 billion noted earlier–approximately 0.034 percent of annual GDP, well below the 6.3% provided to fund the National Highway System in 1956. State Dam Safety Officials offer a funding distribution methodology based on a project ranking system to address the most critical problems first.

This case study of the nation's dams show how the visionary infrastructure improvement plan could be implemented. The total challenge facing the United States is formidable, requiring a $1.6 trillion solution, equivalent to approximately 15% of GDP. However, the significant long-term economic benefits and funding alternatives allow the nation to address the situation before the problem grows any worse. Viable solutions are available, but only visionary leadership can trigger the process leading to these solutions.

Spending on additional security measures after the tragic attacks of 11 September 2001 is now a reality. However, how much federal spending can the government afford for security given other national priorities? Public concerns over excessively large public (and private sector) expenditures on homeland security could jeopardize the fiscal discipline of the federal government. Expenditures by the federal government on Homeland Security issues approached $38 billion in FY 2003–approximately 0.35 percent of our GDP.[36] Spending by state and local governments on homeland security should total about $1.3 billion in 2003[37]. Table 2 shows combined state and federal spending on homeland security:

Homeland Security Budget State Spending	Cost (Billions of Dollars)	Cost (Percentage of 2003 GDP)
Federal HLS Budget	38.0	0.35
State/Local Governments	1.3	0.01

TABLE 2 FY 2003 HOMELAND SECURITY EXPENDITURES[38]

Resource allocation at the federal level is a complex and difficult process. To succeed the recommended proposal allocates scarce public investment dollars to promote maximum private investment. Infrastructure revolving funds/loans, similar to PENNVEST, are an example of how limited federal funding can promote additional private investment. The economic benefits include economic stimulation, job creation throughout the nation, and advancement of public-private partnerships via tax incentives.

Other more politically challenging funding options could be considered. Examples include increased user fees/taxes targeted to upgrading specific infrastructure sites of interest, such as Hoover or Grand Coulee Dam. Alternatively, shifting budget resources from lower priority programs is also an option, although it would be extremely difficult to identify lower priority programs given the nature of our national budgeting process.

Incentives and funding from other sources are also available. One example, private-public underwriting of insurance premiums, similar to national flood insurance, could improve infrastructure while meeting demands to reduce financial liability. Additionally, new legislation could eliminate the legal barriers preventing effective homeland security private-public partnerships, thus overcoming many of obstacles that to date have prevented such partnerships in the past. EZ pass type interstate tolls and a national lottery could provide infrastructure funding, but they may not be desirable for social and/or political reasons.

RISK

There are significant economic and political risks in pursuing such an immense resource-dependent program to upgrade our national infrastructure. The pursuit of improved infrastructure involves trade-offs. What America needs is a balanced program, one which doesn't pay large amounts for small gains. Therefore, convincing Americans to invest in such an aggressive program in the current economic environment may not be feasible or seem affordable, especially given the magnitude of the resources required. Federal discretionary spending is limited unless the nation is willing to endure additional current taxes or greater current deficits. However, the consequences for doing nothing are so great that the

administration must convince the electorate that not investing is too risky given the status of our infrastructure today. As we have seen, the estimated cost to restore the nation's infrastructure exceeds $1.6T. Nevertheless, we must recall that only a portion of the funding needs to come from public sources.

The second- and third-order affects of increased federal spending on infrastructure, both positive and negative, should be considered. On the negative side, implementation of the program risks an increased deficit and expansion of the national debt. A recent Congressional Budget Office (CBO) report suggests the federal government may not have the flexibility to adopt new requirements. The report suggests that both the administration and Congress have failed to curb the growth of the federal deficit. Indeed, current projections suggest we are on a course of nearly doubling the federal debt to $7.7T in 2008[39]. The current year's deficit stood at $374B on 30 September 2003[40]. That number could grow as high as $488B by the end of 2004[41]. Discretionary spending on homeland security issues is also ripe for abuse from politicians looking to cash in on projects for their districts. The visionary approach, like all idealistic ventures, could easily lead to an astronomical expansion of the federal deficit and national debt.

Financing an expanded national debt would be difficult because the internationalization of financial markets greatly influences deficit and debt financing. Today, approximately 44.0 percent of the US national debt is held by foreign investors[42]. As of November 2003, Japanese investors held $525 billion (15%) of the $3.4 trillion in outstanding US treasury securities, and Chinese investors another $144 billion (4%). Therefore, the United States government could find it difficult to find lenders because of the mobility of capital, or if the holders of US national debt threatened to sell the holding simultaneously. Similarly, spending of this magnitude could spur inflation throughout the nation. Finally, some critics may argue the program is too wasteful, much like the civil defense expenditures in the 1950s that provided American citizens with a somewhat false sense of security and many holes in their back yards.

On the positive side, this program should spur additional research and development projects, as well as the creation of additional small businesses to support the implementation. The number of jobs created, both entry level and high tech, by the program would be the second significant benefit. Thirdly, as we progress further into the information age, many of our institutions, both public and private, need newer infrastructure to remain world leaders in education and technology. Finally, and most importantly, many economists agree that federal spending on the nation's infrastructure will lead to higher productivity across all sectors of the economy[43].

CONCLUSION

This paper advocates a visionary effort for Critical Infrastructure. It contends that the nation's infrastructure has two major vulnerabilities, not just the security problems associated with the terrorism threat as suggested by the strategy. The second and possibly more-plausible threat arises from poor maintenance brought about by years of neglect.

This proposal poses some economic risks, but the nation risks more by not investing in its future today. The current Critical Structure Strategy has framed the problem and identified the security vulnerabilities of our national infrastructure. The federal government must now embark on the ambitious journey proposed in this paper to rebuild American infrastructure as part of a wholesale investment in America. Such an investment will significantly increase our economic, political, military, and information power. The cause is noble given the dynamic nature of the world today. It provides a clear message that terrorists cannot destroy American strength, but may in fact contribute to a strengthened America.

WORD COUNT=5,987

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